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Federal Communications Commission
Office of the Secretary

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August 8, 2011

Marlene H. Dortch, Esquire
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

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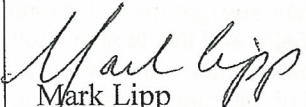
Re: **Request for Experimental Authorization**
Cumulus Licensing, LLC
Station W256BO, Atlanta, Georgia
Facility Identifier Number 148550

Dear Ms. Dortch:

Transmitted herewith in triplicate on behalf of Cumulus Licensing, LLC ("Cumulus"), licensee of Station W256BO, Atlanta, Georgia, is its request for an experimental authorization to operate this Station with a technology developed by Omnia Audio known as single sideband suppressed carrier (SSBSC) modulation of the stereo subcarrier in the FM multiplex baseband signal. This concept is an option to the present double sideband suppressed carrier (DSBSC). A white paper is attached along with a letter from Frank Foti, President of Omnia Audio, describing how this system works. The purpose of this experiment is to test whether multipath can be reduced through a reduction of occupied bandwidth and sideband pairs of the modulated carrier. The enclosed letter also describes the benefits that can be achieved in addition to the multipath reduction. Cumulus proposes to commence these tests as soon as possible and requests authority to continue the testing for up to one year. At the end of the testing period, Omnia will provide Cumulus with a technical report which will be submitted to the FCC.

Accordingly, pursuant to Section 73.1510 of the Commission's Rules, Cumulus respectfully requests an experimental authorization to operate KFOG with the single sideband suppressed carrier.

Sincerely,


Mark Lipp

(Counsel to Cumulus Licensing, LLC)

At this time, we have mapped out a plan that would enable in-field testing to determine if the SSBSC method does reduce the perceptible effect of multipath. We wish to confirm the results acquired in lab testing. Aside from that, we intend to observe occupied bandwidth, as well as testing to see if there is any change in adjacent channel performance. Omnia will over see the in-field testing and will provide a report of its findings.

Upon completion of testing, should the consensus of the NRSC group support the concept, then we would embark upon the proper procedures with regards to where we proceed next.

Our company, Omnia Audio, has researched, designed, and implemented a SSBSC option for the stereo generator function employed in our Omnia.11 FM audio processor. Thus, activation of the technology is readily available for implementation.

Should you desire any additional information about this, please do not hesitate to contact the undersigned.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Frank Foti', with a stylized flourish at the end.

Frank Foti
President, Omnia Audio

Silver Anniversary Of FM-Stereo

April, 2011 marks 50 years since the Federal Communications Commission (FCC) approved stereophonic transmission for the United States. The Commission, after evaluating fourteen proponents, decided upon a method that was of similar design from both Zenith and General Electric.

A quick refresher course how the Zenith/GE system works, courtesy of subpart 73 from the FCC Rules and Regulations:

§ 73.322 FM stereophonic sound transmission standards.

- (a) An FM broadcast station shall not use 19 kHz \pm 20 Hz, except as the stereophonic pilot frequency in a transmission system meeting the following parameters:
 - (1) The modulating signal for the main channel consists of the sum of the right and left signals.
 - (2) The pilot subcarrier at 19 kHz \pm 2 Hz, must frequency modulate the main carrier between the limits of 8 and 10 percent.
 - (3) One stereophonic subcarrier must be the second harmonic of the pilot subcarrier (i.e., 38 kHz) and must cross the time axis with a positive slope simultaneously with each crossing of the time axis by the pilot subcarrier. Additional stereophonic subcarriers are not precluded.
 - (4) Double sideband, suppressed-carrier, amplitude modulation of the stereophonic subcarrier at 38 kHz must be used.
 - (5) The stereophonic subcarrier at 38 kHz must be suppressed to a level less than 1% modulation of the main carrier.
 - (6) The modulating signal for the required stereophonic subcarrier must be equal to the difference of the left and right signals.
 - (7) The following modulation levels apply:
 - (i) When a signal exists in only one channel of a two channel (biphonic) sound transmission, modulation of the carrier by audio components within the baseband range of 50 Hz to 15 kHz shall not exceed 45% and modulation of the carrier by the sum of the amplitude modulated subcarrier in the baseband range of 23 kHz to 53 kHz shall not exceed 45%.
 - (ii) When a signal exists in only one channel of a stereophonic sound transmission having more than one stereophonic subcarrier in the baseband, the modulation of the carrier by audio components within the audio baseband range of 23 kHz to 99 kHz shall not exceed 53% with total modulation not to exceed 90%.

The FM-Stereo system, as described above, has worked quite well for 50 years, but not without challenges. Most notable is multipath distortion, especially in areas of hills or mountainous terrain. Also, radio broadcasters have added incremental signals within the multiplexed spectra. Radio Data Services (RDS), as well as a 92 kHz based SCA can additionally occupy the signal, if desired by the broadcaster. Modulation index of the FM carrier is further reduced with each and every added signal, thus increasing the sensitivity of multipath distortion in the receiver.

Since the inception of stereophonic broadcasting, there has been no technical change to the infrastructure of the Zenith/GE system at all. The FCC rules are quite specific regarding the multiplex spectrum, and its interoperability as a system. After 50 years of service, the system works fairly well, but it could be better. Considering the above mentioned challenges, and the alternatives a listener now has, it makes practical, as well as good business sense to investigate improvements to the present system. It stands to reason that any means proposed, must be backward compatible with existing stereo receivers. Also, after 50 years, a nice anniversary present is in order!

Technical Challenges For FM-Stereo

Another known challenge for the system is the compromised signal-to-noise (SNR) level when broadcasting stereo. FM transmission noise will rise at 6dB per octave over the channel's passband range of 99 kHz. It has been generally accepted that FM-Stereo suffers a 23dB noise penalty compared to monophonic broadcasting. This is due to the rising noise floor over the subcarrier range of 23 kHz – 53 kHz, as compared to the SNR over the range of 0 Hz – 15 kHz which is used for mono. Figure – 2 is an illustration of the composite baseband signal. Figure – 3 shows the 6dB/octave noise floor slope of an FM channel, as it would appear at the output of an IF section in a receiver. Figure – 4 represents the SNR response through the composite baseband signal. This illustration superimposes the noise response across the composite spectrum. It is easy to observe the most severe noise spectra occurs in the upper sideband of the stereo subchannel.

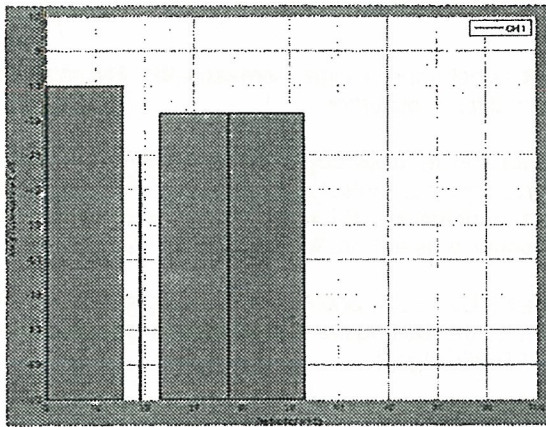


Figure – 2, Baseband Spectra

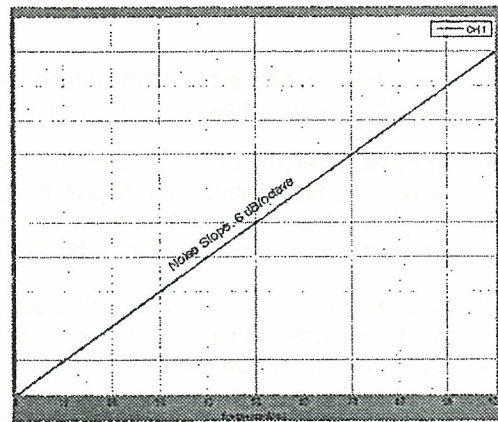


Figure – 3, FM Channel Noise Response

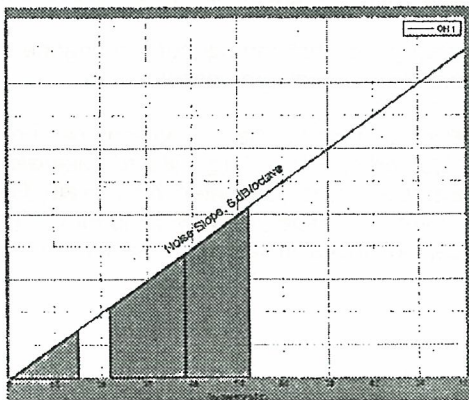


Figure – 4, Receiver IF Output SNR

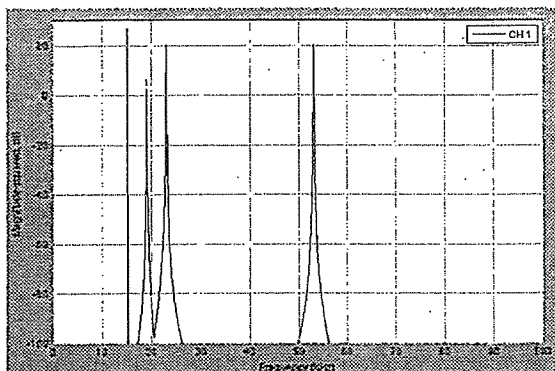


Figure – 5, 15 kHz tone, single channel, DSBSC

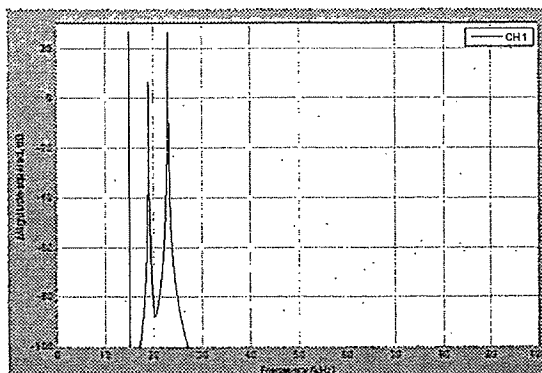


Figure – 6, 15 kHz tone, single channel, SSBSC

Note the 6dB increase in level of the SSB carrier in Figure – 6. This illustrates the manner in which the L+R/L-R mathematics are upheld in the receiver.

Easy to observe the significant difference in spectrum used. The DSBSC method forces the single channel condition of 15 kHz to exist across a broad range. The fundamental is at 15 kHz, and the two sidebands are at 23 kHz and 53 kHz respectively. The DSBSC example illustrates the fragility in faithful reproduction of stereophonic high frequencies during instances of multipath. The group delay at 15 kHz, 23 kHz, and 53 kHz becomes non-linear, during multipath, and this is why stereophonic high frequencies are so fragile with respect to multipath.

Compare the spectra of Figure – 5 with that of Figure – 6. The close proximity of the 15 kHz fundamental, and the 23 kHz SSB carrier improves high frequency robustness during multipath. Due to the closeness of these two frequencies, there is less adverse affect when multipath non-linearities are created, and high frequency stereophonic performance is audibly improved.

Using a noise source in one channel, the same tests were performed. The results are illustrated in Figures 7 & 8.

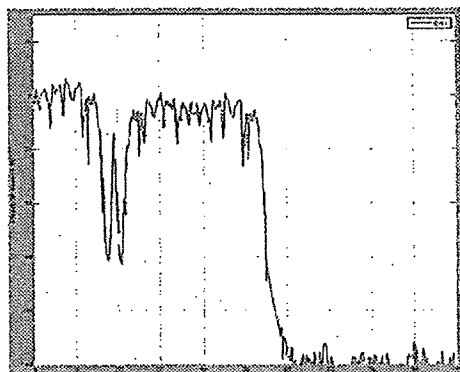


Figure – 7, noise, single channel, DSBSC

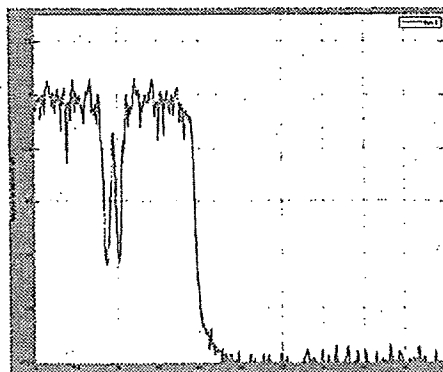


Figure – 8, noise, single channel, SSBSC

SSB subchannel modulation makes FM channel occupancy more efficient. Figure – 9 demonstrates carrier deviation of the RF signal using DSBSC modulation of a single channel noise source. Figure – 10 is the same test signal, except SSBSC modulation is employed. For the example shown here, the carrier frequency is 400,000 kHz, with deviation set to 4 kHz.

What's Next...

Transmitting SSBSC modulation of the FM-Stereo signal can be done right now! Software exists to implement this method today. One minor item must be addressed: FCC rule 73.322, section (A), subpart (4) which states "Double sideband, suppressed-carrier, amplitude modulation of the stereophonic subcarrier at 38 kHz must be used." Seems there was a time, when rule 73.322(A)(4) was required. Times have changed. Both transmission and reception firmware have improved significantly to enable a change in the rules and regulations governing the FM-Stereo baseband signal.

The theory, testing, and findings presented here should be more than enough evidence for the FCC to consider, at the very least, a Special Temporary Authority (STA) to enable all broadcasters to implement the SSBSC transmission method. Benefit will occur immediately to those whom employ this, especially those in areas of rough terrain with significant hills, and mountains.

After 50 years of service, a modification to the rules and regulations governing FM-Stereo service would be a wonderful anniversary present indeed! Most importantly, the benefactors are the general public - radio listeners, as audible annoyances will be suppressed, and in some cases eliminated. At a time when broadcasters are looking to find every possible way to enhance their customers (the listener's) experience, this change in the rules would benefit everyone. This is total upside, with nothing downside for all.

The author would like to thank William Gillman for his exceptional paper written in 1997, which provided a point of reference in this investigation. Additionally, thanks to Steve Church for his support and enthusiasm in our joint audio processing, and transmission system efforts.